3D Velocity Flows in Flare Productive and Dormant Active Regions

R. A. Maurya and A. Ambastha

Udaipur Solar Observatory, Physical Research Laboratory , P.O. Box No. 198, Udaipur-313001 (India)

Summary. During Solar Cycle 23, some active regions(ARs) produced extremely energetic flares and CMEs. These ARs are expected to be characteristically distinct as compared to dormant ARs and quiet regions (QRs). It would be interesting to identify whether the internal structure and dynamics of the ARs is related to their flaring/CME activity levels. For this investigation, we have obtained sub-surface velocity flows in several ARs and QRs using the ring diagram technique, and then derived the corresponding vorticity vector and kinetic helicity density.

From our study of several active (and corresponding quiet) regions, we report the following: (i) Flare productive ARs show stronger internal zonal/meridional flows as compared to QRs. (ii) Strong down-flows have better association with larger magnetic activity. (iii) The sign change in zonal/meridional velocity gradients observed at the depth of 3-5 Mm is associated with larger magnetic activity. (iv) The steep meridional velocity gradient, reported earlier by Ambastha et al. (2004) at $\approx$ 5 Mm depth in NOAA 10486, was further corroborated. (v) Relationship of this steep gradient with flare-productivity was found to hold good in some other ARs also. (vi) Total unsigned kinetic helicity density was well correlated with the unsigned magnetic activity index (MAI). (vii) Vertical vorticity changed sign for ARs located in the N-, and S-hemispheres. (viii) Total unsigned kinetic helicity density of ARs correlated remarkably well with the X-ray (Komm et al. 2004) and Hα flare indices. (ix) Flare productive ARs possessed larger kinetic helicity density in sub-surface flows as compared with the corresponding QRs. Detailed report of this paper is to be submitted else where.

Acknowledgement. This work utilizes data obtained by the Global Oscillation Network Group (GONG) program, which is operated by AURA, Inc.

References

Ambastha, A., Basu, S., Antia, H. M., Bogart, R. S. 2004, in SOHO 14 Helio- and Asteroseismology: Towards a Golden Future, ed. D. Danesy, ESA Special Publication, 559, 293

Komm, R., Howe, R., González Hernández, I., et al. 2004, in SOHO 14 Helio- and Asteroseismology: Towards a Golden Future, ed. D. Danesy, ESA Special Publication, 559, 158